

8. Quality Assurance

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Abstract

The overall goal of a well-designed and well-implemented sampling and analysis program is to measure accurately what is really there. Environmental decisions are made on the assumption that analytical results are, within known limits of accuracy and precision, representative of site conditions. Many sources of error exist that could affect the analytical results. Factors to consider as sources of error include improper sample collection, handling, preservation, and transport; inadequate personnel training; and poor analytical methods, data reporting, and record keeping. A quality assurance program is designed to minimize these sources of error and to control all phases of the monitoring process.

8.1 INTRODUCTION

The application of a quality assurance/quality control (QA/QC) program for environmental monitoring activities at the ORR is essential to generating data of known and defensible quality. Each aspect of the environmental monitoring program, from sample collection to data management, must address and meet applicable quality standards.

The 1996 QA/QC results for the three sites have been compiled into a summary that represents the performance of the reservation as a whole. In past years, the results were reported separately for each of the three site analytical laboratories. In 1995, the three laboratories were combined into a single entity, the Analytical Services Organization. The 1996 results are based on data from the Analytical Services Organization, ESD, the ORNL Industrial Hygiene Department, and the ETPP Technical Division.

8.2 FIELD SAMPLING QUALITY ASSURANCE

Field sampling QA encompasses many practices that minimize error and evaluate sampling performance. Some key quality practices include the following:

- use of standard operating procedures (SOPs) for sample collection and analysis;

- use of chain-of-custody and sample-identification procedures;
- instrument standardization, calibration, and verification;
- technician and analyst training;
- sample preservation, handling, and decontamination; and
- use of QC samples such as field and trip blanks, duplicates, and equipment rinses.

Preparation of SOPs is a continually evolving process. In 1988, the Environmental Surveillance Procedures QC Program was issued for use by Martin Marietta Energy Systems, Inc., with oversight by DOE-ORO and the EPA.

A process is in place for continuous improvement in the field sampling QA program and for incorporation of new procedures to reflect changing technologies and regulatory protocols. The Environmental Surveillance Procedures QC Committee is tasked with updating the field sampling and QC procedures. Membership in the committee includes representatives from each of the five Lockheed Martin facilities, DOE, ER, Central Waste Management, and the Analytical Services Organization. The committee ensures that requirements from relevant federal and state regulations are incorporated into the procedures and that new procedures are incorporated only after appropriate review and approval. In addition, site-specific procedures are reviewed internally.

Because of changing technologies and regulatory protocols, training of field personnel is a continuing process. To ensure that qualified

personnel are available for the array of sampling tasks within Lockheed Martin, training programs by EPA as well as private contractors have been used to supplement internal training. Examples of topics addressed include the following:

- planning, preparation, and record keeping for field sampling;
- well construction and groundwater sampling;
- surface water, leachate, and sediment sampling;
- soil sampling;
- stack sampling;
- decontamination procedures; and
- health and safety considerations.

8.3 ANALYTICAL QUALITY ASSURANCE

The Lockheed Martin analytical laboratories have well-established QA/QC programs, well-trained and highly qualified staff, and excellent equipment and facilities. Current, approved analytical methodologies employing good laboratory and measurement control practices are used routinely to ensure analytical reliability. The analytical laboratories conduct extensive internal QC programs with a high degree of accuracy, participate in several external QC programs, and use statistics to evaluate and to continuously improve performance. Thus, QA and QC are daily responsibilities of all employees.

8.3.1 Internal Quality Control

Analytical activities are supported by the use of standard materials or reference materials (e.g., materials of known composition that are used in the calibration of instruments, methods standardization, spike additions for recovery tests, and other practices). Certified standards from the National Institute of Standards and Technology (NIST), EPA, or other DOE laboratories are used for such work. The laboratories operate under specific QA/QC criteria at each installation. Additionally, separate QA/QC documents relating

to analysis of environmental samples associated with regulatory requirements are developed.

QA/QC measurement control programs external to the sample analysis groups have single-blind control samples submitted to the analytical laboratories to monitor performance. The results of such periodic measurement programs are statistically evaluated and reported to the laboratories and their customers. Most reports are issued quarterly, and some laboratories compile annual summary reports. These reports assist in evaluating the adequacy of analytical support programs and procedures. If serious deviations are noted by the QC groups, the operating laboratories are promptly notified so that corrective actions can be initiated and problems can be resolved. QC data are stored in an easily retrievable manner so that they can be related to the analytical results they support.

8.3.2 External Quality Control

In addition to the internal programs, all Lockheed Martin analytical laboratories are directed by DOE and are expected by EPA to participate in external QA programs. The QA programs generate data that are readily recognizable as objective packets of results. The external QA programs typically consist of the Lockheed Martin laboratories analyzing a sample of unknown composition provided by various QA organizations. The organizations know the true composition of the sample and provide the Lockheed Martin laboratories with a data report on their analytical performance. The sources of these programs are laboratories in EPA, DOE, and the commercial sector. Lockheed Martin participates in ten such programs (Table 8.1). The following sections describe the external QA programs in which Lockheed Martin participates.

8.3.2.1 EPA Contract Laboratory Program

The Contract Laboratory Program (CLP) is an EPA-administered QA element used to evaluate laboratory analytical proficiency in comparison with analyte and the current state of work. The

Table 8.1. QA/QC results for the Oak Ridge Reservation, 1996

Program	Total number of analytes	Acceptable	
		Total	Percentage
EPA Contract Laboratory Program (CLP) ^a			83.27
EPA Water Supply Laboratory Performance Quality Control Program (Water Supply)	302	283	93.71
EPA Water Pollution Performance Evaluation Quality Control Program (Water Pollution) ^c and Discharge Monitoring Quality Assurance Study	231	226	97.84
AIHA Proficiency Analytical Testing Program ^b	292	287	98.29
EPA Intercomparison Radionuclide Control Program ^b	157	151	96.18
AIHA Environmental Lead Proficiency Analytical Testing Program	72	71	98.61
DOE Mixed Analyte Performance Evaluation Program	140	133	95.00
DOE Environmental Measurements Laboratory Quality Assessment Program	268	255	95.15
Proficiency Environmental Testing Program	3229	3166	98.05

^aThe CLP scores its results on other factors besides quantitation. An average score was determined by averaging each site's average score from the CLP.

^bIncludes asbestos data from the ETTP Technical Division and organics and asbestos data from the ORNL Industrial Hygiene Department, as well as data from the Analytical Services Organization.

^cIncludes toxicology data from the ORNL Environmental Sciences Division in addition to the Analytical Services Organization.

program operates from the EPA Contract Laboratory Analytical Services Support office at Alexandria, Virginia, in cooperation with the EPA regional offices. This program evaluates laboratories for the determination of organic and inorganic contaminants in aqueous and solid hazardous waste materials and enforces stringent QA/QC requirements to ensure comparable data. This program scores on additional criteria other than an "acceptable-unacceptable" evaluation of the measurement result. By the CLP scoring algorithm, performance of 75% or better indicates acceptable performance. Values below this score indicate that deficiencies exist and that the participant has failed to demonstrate the capability to meet the contract requirements.

8.3.2.2 EPA Water Supply Laboratory Performance Quality Control Program

This program is administered by EPA and is used by the state of Tennessee to certify laboratories for drinking water analysis. To maintain a certification, a laboratory must meet a specified set of criteria relating to technical personnel, equipment, work areas, QA/QC operating procedures, and successful analysis of QA samples. In addition, inclusion on the state of Tennessee's UST approved listing may be granted as a result of successful participation in this program. This program is also used by other states as part of their certification programs.

8.3.2.3 Combined EPA Water Pollution Performance Evaluation Quality Control Program and EPA Discharge Monitoring Report Quality Assurance Study

During 1996 the EPA Water Pollution Performance Evaluation Quality Control Program was combined with the EPA Discharge Monitoring Report Quality Assurance Study.

The Water Pollution Performance Evaluation Quality Control Program is used by EPA to evaluate laboratories engaged in analysis of polluted water samples at existing and former DOE sites. It is administered by the EPA laboratory in Cincinnati, Ohio, (Region 5) and is utilized by some states as part of their laboratory certification process.

EPA conducts the national Discharge Monitoring Report Quality Assurance Study in support of the NPDES permits. Use of the program is mandatory for major permit holders. EPA supplies the QA samples and furnishes the evaluated results to the permittee, who is required to report the results and any necessary corrective actions to the state or regional coordinator.

8.3.2.4 American Industrial Hygiene Association Proficiency Analytical Testing Program

The American Industrial Hygiene Association (AIHA) administers the Proficiency Analytical Testing Program as part of its AIHA accreditation process for laboratories performing analyses of industrial hygiene air samples.

8.3.2.5 EPA Intercomparison Radionuclide Control Program

The EPA Intercomparison Radionuclide Control Program is administered by the National Exposure Research Laboratory at Las Vegas (NERL-LV). Samples are composed of a water matrix. The state of Tennessee requires participation for drinking-water certification of

radionuclide analysis. This program is also used by other states as part of their laboratory certification process. The NERL-LV program calculates a normalized standard deviation for each laboratory based on all reported results. By its criteria, any reported value above three standard deviations is considered unacceptable.

8.3.2.6 AIHA Environmental Lead Proficiency Analytical Testing Program

The Environmental Lead Proficiency Analytical Testing Program (ELPAT) is administered by AIHA. It was established by AIHA in 1992 to evaluate analysis of environmental lead samples in different matrices. The matrices evaluated are paint, soil, and dust wipes. The participating laboratory can analyze each matrix at four levels. In addition, a laboratory may request to become accredited for lead analysis in this program.

8.3.2.7 DOE Mixed Analyte Performance Evaluation Program

The Mixed Analyte Performance Evaluation Program (MAPEP) is a program set up by the DOE Radiological and Environmental Sciences Laboratory in conjunction with the Laboratory Management Division of the Office of Technology Development to evaluate analysis of mixed-waste samples. MAPEP is evaluated by Argonne National Laboratory. Participation is required by DOE for laboratories that perform environmental analytical measurements in support of EM activities.

8.3.2.8 DOE Environmental Measurements Laboratory Quality Assessment Program

Participation in the radionuclide Quality Assessment Program, administered by DOE Environmental Measurements Laboratory (EML) in New York, is required by DOE Order 5400.1. Various matrices, such as soil, water, air filters, and vegetation, are submitted semiannually for

analysis of a variety of radioactive isotopes. All matrices, except air filters, are actual materials obtained from the environment at a DOE facility. A statistical report is submitted to the sites by EML for each period.

8.3.2.9 Proficiency Environmental Testing Program

The Proficiency Environmental Testing program is a service purchased from an outside vendor and is used by all five Lockheed Martin analytical laboratories and the DOE laboratory at the Fernald, Ohio, facility to meet the need for a QA program for all environmental analyses. The samples are supplied by the commercial company at two concentration levels (high and low). All data from each of the six laboratories are reported to the supplier. The commercial supplier provides a report on the evaluated data to the site QA/QC managers. The report includes a percentage recovery of the referenced value, deviation from the mean of all reported data, specific problems in a site laboratory, and other statistical information. A corporate report is also provided that compares the data from the Lockheed Martin laboratories with those of other corporate laboratories.

8.3.3 Quality Assessment Program for Subcontracted Laboratories

A buy/make assessment has been established for each project that requires analytical work. Based on the results of this assessment, work is managed in-house or is placed with a subcontractor through the Sample Management Office (SMO). A competitive award system has been established to place analytical work. The SMO provides single-source sample management for the reservation by supporting several organizations, including Jacobs Engineering, Bechtel National, and the EM section of EMEF at LMES. The SMO anticipates placing work with 13 commercial laboratories on a yearly basis. Laboratories approved by the SMO are required to comply with the requirements set forth in the Analytical Sup-

port Agreement terms and conditions. Oversight of subcontracted commercial laboratories is performed by DOE, which is supported by the SMO. DOE, SMO, and subcontractors conduct on-site laboratory reviews and monitor the performance of all subcontracted laboratories.

8.4 DATA MANAGEMENT, VERIFICATION, AND VALIDATION

Verification and validation of environmental data are performed as components of the data collection process, which includes planning, sampling, analysis, and data review. Verification and validation of field and analytical data collected for environmental monitoring and restoration programs are necessary to ensure that data conform with applicable regulatory and contractual requirements. Validation of field and analytical data is a technical review performed to compare data with established quality criteria to ensure that data are adequate for intended use. The extent of project data verification and validation activities is based upon project-specific requirements.

Over the years, the environmental data verification and data validation processes used by ORR environmental programs have evolved to meet continuing regulatory changes and monitoring objectives. Procedures have been written to document the processes. For routine environmental effluent monitoring and surveillance monitoring, data verification activities may include processes of checking whether (1) data have been accurately transcribed and recorded, (2) appropriate procedures have been followed, (3) electronic and hard-copy data show one-to-one correspondence, and (4) data are consistent with expected trends. For example, the requirements for self-monitoring of surface-water and wastewater effluents under the terms of an NPDES permit require the permittee to conduct the analyses as defined in 40 CFR 136 and to certify that the data reported in the monthly discharge monitoring report are true and accurate.

Typically, routine data verification actions alone are sufficient to document the truthfulness

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and accuracy of the discharge monitoring report. For restoration projects, routine verification activities are more contractually oriented and include checks for data completeness, consistency, and compliance against a predetermined standard or contract.

Certain projects may perform a more thorough technical validation of the data as mandated by the project's data quality objectives. For example, sampling and analyses conducted as part of a remedial investigation to support the CERCLA process may generate data that are needed to evaluate risk to human health and the environment, to document that no further remediation is necessary, or to support a multimillion-dollar construction activity and treatment alternative. In that case, the data quality objectives of the project may mandate a more thorough technical evaluation of the data against predetermined criteria. For example, EPA has established functional guidelines for validation of organic and inorganic data collected under the protocol of the EPA's CLP. These guidelines are used to offer assistance to the data user in evaluating and interpreting the data generated from monitoring activities that require CLP performance.

The validation process may result in identifying data that do not meet predetermined QC criteria (in flagging quantitative data that must be considered qualitative only) or in the ultimate rejection of data from its intended use. Typical criteria evaluated in the validation of CLP data include the percentage of surrogate recoveries, spike recoveries, method blanks, instrument tuning, instrument calibration, continuing calibration verifications, internal standard response, comparison of duplicate samples, and sample holding times.

Electronic data transfers from portable computers in the field and from laboratory information management systems used by on-site and commercial analytical laboratories to environmental data management systems have greatly enhanced the efficiency of the review process. In addition, the ongoing development of data-review software applications continues to provide necessary tools for data review. For example, as groundwater

monitoring data are compiled, computer capabilities accomplish the following tasks:

- calculate charge balance;
- calculate conductivity and compare the data with field and laboratory measurements of conductivity;
- compare alkalinities and pH, field-duplicate measurements, results of filtered and unfiltered samples for elemental analyses, and current data with historical data to note results that are statistical outliers from established patterns;
- generate a summary of holding times for volatile organics; and
- screen volatile-organic results from samples against volatile-organic results from laboratory blanks.

Irregularities in the laboratory results that are discovered through this program are flagged and reviewed with the laboratory. If corrections need to be made, the laboratory provides a revised laboratory report. If a data point is found to be an outlier, it remains flagged in the data base as information for the data user.

Continuing improvements are being made to computerized environmental data management systems maintained by the Y-12 Plant, ORNL, and ETTP to improve the functionality of the systems, to allow access by a wide range of data users, and to integrate the mapping capabilities of a geographic information system with the data bases containing results of environmental monitoring activities.

Integration of compliance-monitoring data for the ORR with sampling and analysis results from remedial investigations is a function of the Oak Ridge Environmental Information System (OREIS). OREIS is necessary to fulfill requirements prescribed in both the FFA and TOA and to support data management activities for all five facilities managed by Lockheed Martin. The FFA, a tripartite agreement between DOE, EPA Region 4, and the state of Tennessee, requires DOE to maintain one consolidated data base for environmental data generated at DOE facilities on the ORR. According to the FFA, the consolidated data

base is to include data generated pursuant to the FFA as well as data generated under federal and state environmental permits. The TOA further defines DOE staff obligations to develop a quality assured, consolidated data base of monitoring information that will be shared electronically on a near-real-time basis with the state staff.

OREIS is the primary component of the data management program for restoration projects, providing consolidated, consistent, and well-documented environmental data and data products to support planning, decision making, and reporting activities. OREIS provides a direct electronic link of ORR monitoring and remedial investigation results to EPA Region 4 and TDEC/DOE-O.